MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during October, 1886, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and ninety-three vessels have been used.

On this chart is also shown the distribution of icebergs reported during the month.

On chart i for this month are traced the paths of nine areas of low pressure; the average number for October during the last thirteen years being 10.5.

The most severe storm of the month, described as number vi, was quite destructive during its passage over the upper Mississippi valley and the Lake region on the 14th; it was accompanied by high winds and unusually low barometer, the lowest recorded being 28.93, at Mackinaw City, Michigan, at 3 p. m. of the 14th.

Owing to the heavy storm that prevailed in the Gulf of Mexico from the 9th to the 12th very high tides occurred along the Gulf coast on the 12th, causing considerable loss of life and property in Louisiana and eastern Texas.

A noteworthy feature in connection with the meteorology of the month is the fact that the mean barometric readings are decidedly above the normal in all parts of the country lying east of the Rocky Mountains, while the rainfall of the same districts is largely deficient as compared with the normal.

The mean temperature is above the normal in the upper lake region, upper Mississippi valley, Missouri Valley, the extreme northwest, and in eastern Montana; in the Southern States and along the Pacific coast it is below the normal; the departures in the other districts are small.

Under "Notes and extracts" in this REVIEW will be found a paper by Junior Prof. T. Russell containing the results and a short discussion of the comparative readings of still and whirled wet and dry-bulb thermometers as made at thirty-seven Signal Service stations during August and September, 1886.

Mr. M. A. Veeder, of Lyons, New York, furnishes an interesting note on sun spots and attending phenomena.

In addition to the regular reports from the cotton districts a table is given showing the average rainfall and mean of the maximum and minimum temperatures during the growing season from 1882 to 1886, inclusive, also the total acreage and yield of cotton for the first four years mentioned.

In the preparation of this REVIEW the following data, received up to November 20, 1886, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-one Canadian stations, as telegraphed to this office; one hundred and sixty-four monthly journals; one hundred and fifty-six monthly means from the former, and twenty-one monthly means from the latter; two hundred and seventy-eight monthly registers from voluntary observers; fifty-five monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Indiana, Illinois, Iowa, Minnesota, Mississippi, Missouri, Nebraska, New England, Ohio, and Tennessee; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE.

[*Expressed in inches and hundredths.*]

The distribution of mean pressure for October, 1886, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The mean atmospheric pressure of the United States during the month is greatest over the country lying east of the Mississippi River; over this area the pressure averages about 30.17. An examination of chart ii will show that the area of maximum pressure, enclosed by the isobar of 30.20, extends over Tennessee, Kentucky, and the southern part of Indiana and Ohio; within this area the highest pressure, 30.22, occurred at Knoxville, Tennessee. From this isobar the pressure decreases in all directions until the isobar of 30.15 is reached. This line extends along the Atlantic coast from Eastport, Maine, to Savannah, Georgia, and includes the greater portion of the country lying east of the Mississippi River. The area of minimum pressure, within which the mean for the month is 29.95 or less, covers southeastern California, southern Nevada, southwestern Utah, and western Arizona. The lowest barometric mean for the month, 29.91, is reported from Frisco, Utah. Two areas of comparatively low pressure, indicated by the isobar of 30.00, are also found on chart ii; one extends over northern Dakota and Montana, the other covers southern Florida.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The mean pressure for the month, when compared with the normal as deduced from the observations of the past fourteen years, will be found to be in excess in all parts of the country except over a comparatively small area covering the northern and middle plateau regions, where the pressure is normal or slightly below. The largest departures occur in the Ohio and Mississippi valleys, the Lake region, and in Tennessee, where they range from .06 to .13 in excess of the normal. In the states bordering on the Atlantic Ocean and Gulf of Mexico the pressure averages about .06 in excess of the normal, and ranges from .04 at Boston, Massachusetts, to .10 at Galveston and Brownsville, Texas. On the Pacific slope the departures in excess of the normal vary from .02 at Fort Canby, Washington Territory, to .08 at Los Angeles and San Diego, California.

When compared with the mean pressure of the preceding month, September, 1886, an increase is noted in all parts of the United States. The increase is greatest in the Missouri, Mississippi, and Ohio valleys and the Lake region; in these districts it ranges from .10 at Erie, Pennsylvania, to .16 at Leavenworth, Kansas. The increase in California and Arizona is also large, being .15 and .13 at San Francisco and Sacramento, California, respectively, and .19 at Yuma, Arizona. In New England and the Atlantic States the increase is about .04; in the Gulf States it averages .11, one station, Brownsville, Texas, shows an increase of .17.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. The greatest ranges occur in the Lake region and over the northern part of the Mississippi and Missouri valleys; owing to the unusually low pressure that accompanied the storm of the 14th in its passage over the upper Mississippi valley and the Lake region the monthly barometric ranges in those districts are exceptionally large.

The following are some of the extreme monthly ranges:

Greatest.	Inch.	Least.	Inch.
Mackinaw City, Michigan	1.71	Jacksonville, Florida	0.31
Alpena, Michigan	1.65	Sanford, Florida	0.31
Escanaba, Michigan	1.54	San Diego, California	0.34
Marquette, Michigan	1.48	Los Angeles, California	0.35
Grand Haven, Michigan	1.48	Key West, Florida	0.39
Green Bay, Wisconsin	1.47	Cedar Keys, Florida	0.39
Dubuque, Iowa	1.45	Yuma, Arizona	0.40
Milwaukee, Wisconsin	1.42	Savannah, Georgia	0.41
La Crosse, Wisconsin	1.39	Montgomery, Alabama	0.43

AREAS OF HIGH PRESSURE.

[Prepared by Lieut. JOHN C. WALSHE, Signal Corps, U. S. Army, Assistant.]

Ten areas of high pressure appeared within the limits of the United States during the month of October, 1886. The majority of these entered the Pacific coast from the ocean, with a general easterly movement, and three of the others advanced southward over the valley of the Assinaboine, and thence generally in a southeasterly direction. The most noticeable feature of the month was the almost uniformly regular movement eastward. The maximum pressure over the United States occurred on the 25th and 26th, when the area described as number ix covered the whole country, accompanied by low temperature and heavy frosts, extending to the Southern States.

I.—The month opened with a large and well-defined area of high pressure over the upper Mississippi and the Missouri valleys, which moved slowly eastward and was central over Illinois and Indiana at midnight of the 1st. The pressure gradually increased and was considerably above the normal over the entire Mississippi Valley and the Lake region on the 2d. The temperature rose slowly in the Northwest in rear of this area as it moved eastward on the 2d and 3d. The midnight map of the 3d showed the centre of high pressure over the middle Atlantic states, after which date it slowly disappeared into the Atlantic. During the passage of this area general light frosts extended southward to Memphis and Nashville, Tennessee.

II.—On the afternoon of the 2d an area of high pressure entering from the Pacific appeared over Oregon and Washington Territory and gradually moved eastward, extending over the Rocky Mountain region on that date. This area remained nearly stationary on the 3d, developing little increase of pressure. The morning map of the 4th showed it central over Nebraska and Dakota, well defined, and in rear of a low area moving toward the Saint Lawrence Valley. It drew slowly eastward on the 5th over the Lake region, and at the midnight observation of that date was central on Lake Ontario. On the 6th it remained nearly stationary, and then moved slowly down the Saint Lawrence Valley and into the Atlantic on the morning of the 7th, leaving an area of moderately high pressure over the Eastern States, attended by clear or fair weather on the 8th, 9th, 10th, and 11th, with light rains on the coast of the south Atlantic states, finally drawing into the Atlantic Ocean on the 12th. No marked features attended the translation of this area of high pressure eastward other than a slight fall in temperature and generally clear or fair weather.

III.—This area entered from the Pacific coast over northern California and Oregon and was first observed on the morning of the 6th. An area of moderately low pressure on that date extended southward from the Saskatchewan Valley over Dakota and Minnesota, and during the 6th spread still further south until it formed an elliptical trough of low pressure bounded by the isobar of 29.8. To the east of this lay an area of high pressure central over the Lake region. These conditions produced light rains in Colorado on the 6th, and the eastern progress of this area over the Rocky Mountains was retarded. It remained nearly stationary over Utah and Nevada on the 7th, with slowly diminishing pressure, until it lost well-defined outlines as an area of high pressure and gradually dissipated.

IV.—This area was first observed advancing southward over Manitoba on the afternoon of the 10th, and had probably entered from the Pacific over Vancouver Island, where an area of moderately high pressure was noticed on the 9th. A well-defined low area was central over Utah, bounded by the isobar of 29.6, during the last-mentioned date, and the advance of this area of high pressure produced rains in Minnesota, Dakota, and Nevada on the 10th. On the 11th the pressure increased over the Saskatchewan Valley, but appeared to remain stationary—producing a slight fall in temperature and precipitation in the northern lake region on the 12th, after which it dissipated by the gradual decrease of pressure.

V.—This area entered from the Pacific over the coast of California and was first observed on the afternoon of the 12th central over Nevada. An area of moderately low pressure extended over Kansas and northwestern Texas, bounded by the isobar of 29.8, and another depression was central in Manitoba, bounded by the isobar of 29.7. These conditions retarded somewhat the advance eastward of this area, and the pressure at the centre fell slowly to 30.1 as the area increased in extent. It moved slowly southward on the 13th, and the morning map of the 14th showed it central over New Mexico, while a storm of marked energy was moving over Iowa, the pressure having fallen there to 29.10. This area on the 14th began to increase in pressure and move slowly eastward and northward until it formed an area of high pressure advancing southward from the Saskatchewan Valley. The movement of this area, although the pressure was but slightly above the normal, was attended by a marked fall in temperature over the Rocky Mountain region.

VI.—This area moved southward from the Saskatchewan Valley and was first observed on the afternoon of the 14th, at which time a depression of remarkable energy existed in the Lake region. The pressure increased up to midnight and the area widened in extent—the morning map of the 15th showing the maximum pressure extending from Dakota to the valley of the Assinaboine and bounded by the isobar of 30.5, attended with a marked fall in temperature. The barometric gradient extended with great regularity to the coast of Oregon—pressure 29.7, and to the Saint Lawrence Valley, the pressure at Quebec being 29.5. The shape assumed by this high area was elliptical, and the major axis extended from the Assinaboine River to Palestine, Texas. The pressure continued to increase over Minnesota, and the barometer rose to 30.67 at the midnight observation at Saint Vincent, Minnesota. The southeasterly winds on the west side of this high area produced rains in the upper Missouri valley, while the northwesterly winds on the east side produced rains and light snows in the Lake region. It moved slowly southeastward on the 16th, and by midnight was central over Pennsylvania, with reduced

pressure, the isobar of 30.4 bounding New York, Pennsylvania, Ohio, Virginia, and West Virginia, with temperature below the normal. During the 17th it moved slowly off the coast into the Atlantic Ocean, attended by light rains in the Lake region, due to the presence of an area of low pressure.

VII.—This area appeared over the Assinaboine Valley on the morning of the 17th, and on that date moved slowly eastward over Lake Superior, with a slight increase of pressure. While it was not well-defined in outline inside the limits of observation it joined the rear of the area described as number vi and extended from the Mississippi River to the Gulf of Saint Lawrence, the barometric pressure ranging from 30.20 over the Mississippi Valley to 30.43 on the coast of Nova Scotia on the morning of the 18th. General light rains and snow prevailed from New Brunswick to Lake Michigan on the night of the 17th. By midnight of the 18th the centre of high pressure had moved to the mouth of the Saint Lawrence, the barometer slowly rising, and during the 19th it continued moving slowly eastward. The morning map of that date showed the isobar of 30.60 on the New England coast and extending northward to Halifax, with clear or fair weather from the Mississippi River to the Atlantic coast, accompanied by a marked fall in temperature. The midnight map of the 20th showed the western quadrant of this high area central over the Carolinas and Virginia, after which date it slowly drew into the Atlantic leaving an area of low pressure north of the Saint Lawrence, with temperature above the normal, and light rains in the Lake region.

VIII.—The afternoon map of the 19th showed the previously described high area (number vii) moving off the coast into the Atlantic, and in the rear of it an elliptical trough of low pressure extending from Arizona to Minnesota. To the west of this an area of moderately high pressure appeared, reaching from Utah to the coast of California and Oregon. This area advanced eastward with increasing pressure and on the morning of the 20th was central over Colorado and Utah, with a pressure of 30.46 at Salt Lake City, Utah, on the afternoon of that date. An elliptical area, bounded by the isobar of 30.30, covered the entire Rocky Mountain region and extended from eastern Kansas to the Pacific coast, having its major axis nearly due east and west. It moved slowly, with slight increase of pressure, and was central near North Platte, Nebraska, at midnight of the 20th. The morning map of the 21st showed the centre of high pressure at Leavenworth, Kansas, and on that date it moved slowly eastward, decreasing in pressure. It was central at Indianapolis, Indiana, with barometer 30.36 and temperature nearly normal, at the midnight observation of that date. The afternoon map of the 22d showed the centre nearly stationary, with pressure much reduced. On the 23d it moved slowly to the northeast over the Saint Lawrence Valley and Lake Ontario, the pressure slightly increasing at the centre, and followed on the 24th by a depression central over Lake Superior. On the last-named date it slowly disappeared eastward off the coast of Nova Scotia.

IX.—The morning map of the 22d showed an area of high pressure (number viii) over the middle Atlantic states and the Ohio Valley, with another high area over California, which had entered from the Pacific on the 21st. Between these two areas of high pressure an elliptical depression extended from northern Dakota to southern Colorado, and in front of this, general frosts occurred on the night of the 21st, and light rains on the 22d. The area of high pressure over California advanced slowly eastward to the central Rocky Mountain districts on the 22d, and then, with moderately high pressure (30.20), remained nearly stationary, owing to the influence of a depression moving southeastward from Manitoba, which was followed by an area of high pressure. This produced an increase of pressure over Montana and Idaho, and the two high areas merged, moving slowly east, attended by a fall in temperature and increasing pressure at the centre. On the afternoon of the 24th it was central over the upper Missouri valley. The pressure continued to increase slowly and the temperature fell rapidly. The morning map of the 25th showed the maximum pressure in Minnesota. On that date the area increased in extent, moving eastward. The isobar of 30.6 bounded Minnesota, Nebraska, Kansas, western Iowa, and Wisconsin, together with the region north of Lake Superior. The temperature fell markedly in this entire region, and heavy frosts occurred, extending south to the Indian Territory. The maximum pressure at the centre of this high area on the 26th was over 30.70 at La Crosse, Wisconsin. The pressure over the entire United States and British possesions, inside the limits of observation, varied from 30.70, at the centre, to 30.10. On the 26th the movement eastward of the centre was not well defined, and the temperature fell below the freezing point along the line of the major axis from Lake Superior to northern Texas, while light rains fell over nearly the entire region east of the Mississippi River to the Atlantic coast. On the afternoon of the 27th the pressure had fallen to 30.30 and the area gradually dissipated without well-defined movement of translation, and attended with light rains in the Lake region.

X.—An area of moderate pressure, bounded by the isobar of 30.10, covered the valley of the lower Mississippi at the midnight observation of the 28th and, with increasing pressure at the centre, moved slowly northward on the 29th. The afternoon map of that date showed the pressure increased at the centre to 30.20 and the midnight observation showed a pressure of 30.30 central over Indiana and Kentucky. The pressure at the centre continued to increase slowly, attended on the 30th with a marked fall in temperature and frosts, extending south and east to northern Georgia and the Carolinas. This area remained nearly stationary on the 30th and 31st, while an area of low pressure, attended with light rains, was moving northward off the coast of the middle Atlantic and New England states.

AREAS OF LOW PRESSURE.

[Prepared by Lieut. JOHN C. WALSHE, Signal Corps, U. S. Army, Assistant.]

Nine areas of low pressure have been traced from the tri-daily weather charts of the Signal Service for the month of October, 1886. The most remarkable of these disturbances were numbers iv and vi. From the chart it will be readily seen that, as in September, 1886, no area of low pressure passed over the region bounded by the lower lakes, the Mississippi River, the Atlantic Ocean, and the east Gulf shore line. Four of these areas developed in the extreme northwest, two on the Pacific slope, one in the Gulf of Mexico, and one, the severest storm of the month, in Kansas. The tracks of the low areas were generally more to the northward of the Saint Lawrence Valley than the average of previous years, and another noticeable feature of the month is the retrogression of the area of development of storm-centres in the extreme northwest.

The following table shows the latitude and longitude in which each area of low pressure was first and last observed, with the average rate of translation in miles per hour:

Areas of low pressure.	First observed.		Last observed.		Average velocity of translation in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
	° ′	° ′	° ′	° ′	
No. I	50 00	103 00	47 00	82 00	32.0
II	46 00	112 00	49 00	97 00	28.0
III	41 00	112 00	36 00	107 00	19.0
IV	21 00	84 00	33 00	93 00	12.0
V	51 00	114 00	59 00	97 00	32.0
VI	39 00	97 00	48 00	63 00	30.0
VII	41 00	120 00	36 00	107 00	14.0
VIII	47 00	97 00	51 00	64 00	34.0
IX	52 00	111 00	47 00	80 00	32.0

Average rate of movement, 26 miles per hour.

I.—This depression was first observed developing in the valley of the upper Missouri on the morning of the 2d, in rear of an area of moderately high pressure central over the Mississippi Valley and the Middle States. It developed comparatively little energy inside the limits of observation and moved

eastward through the Canadian Provinces until it dissipated by a gradual increase of pressure on the morning of the 4th.

II.—This area developed on the morning of the 8th in Montana, while another of moderately low pressure, attended by light rains, was central in northwestern Texas. It became more clearly defined in the afternoon as an elliptical depression, bounded by the isobar of 29.70, extending in a southwesterly direction over the northern Rocky Mountain region. The pressure decreased in the northern part of this ellipse, attended with a light rainfall in the northwestern territories, but developed little energy and remained nearly stationary on the 9th, extending in a trough of low pressure from Colorado and Utah to northern Minnesota, the northern part of which filled up and gradually dissipated after that date.

III.—During the afternoon of the 9th the depression described in number ii underwent a transformation. The southern part developed a considerable decrease of pressure. The midnight map of that date showed a low area well defined and central at Salt Lake City, Utah, bounded by the isobar of 29.5, with brisk to high southeast winds at Fort Bridger, Wyoming. It moved very slowly to the southeast on the 10th, and then assumed a retrograde movement to the southwest on the morning of the 11th. After that date it oscillated without any display of energy and remained a low area, without well-defined outlines, until it finally became merged in a storm which had entered Texas from the Gulf of Mexico.

IV.—This area was first observed in the Gulf of Mexico on the 8th, south of Cuba, and passed southward between Capes Catoche and San Antonio. The track of the storm-centre is as closely approximated as the rather meagre vessel reports would permit. It is the only tropical disturbance occurring during the month. On the 12th the centre of disturbance approached Galveston, Texas, where the barometer fell rapidly, and a high northwesterly gale set in, reaching a velocity of fifty-five miles per hour at 10.15 p. m. of that date. It then turned northward and on the 13th lost the marked energy which had hitherto characterized its motion. It filled up by gradual increase of pressure and was merged in the trough of low pressure which extended from Lake Superior to northern Louisiana. In this trough the most energetic disturbance of the month originated, and is herein described as number vi.

The following notes from Signal Service observers are of interest in connection with this storm:

Sanford, Florida: heavy rain began falling at 12.15 a. m. of the 10th and continued until 3.15 p. m. of the 11th; total precipitation, 4.24 inches. The barometer fell slowly during the 10th and rose on the 11th: brisk easterly winds prevailed on both days.

New Orleans, Louisiana: on the 11th a wind-storm from the east began at 8.15 p. m.; maximum velocity, thirty-eight miles per hour from the northeast at 11.35 p. m.; the high wind continued until 4.30 p. m. of the 12th. Considerable damage was done in the city and surrounding country by the high tide, causing numerous breaks in the navigation and drainage canals. In the Parish of Plaquemines, forty miles below the city, the waters from the Gulf were backed up over the rice fields for a distance of thirty-five miles inland. At the Mississippi quarantine station the storm was very severe, the wind blowing a northeasterly gale for thirty-six hours, causing a high tide which broke the levees and flooded many miles of rice plantations and orange groves.

Port Eads, Plaquemines parish, Louisiana: widespread damage was done by the storm of the 11th and 12th. The wind blew hard on the 10th, and by the morning of the 11th had increased in force, attaining at noon the velocity of a high gale. The water of the Gulf was very high on the 10th and continued to rise on the 11th until Port Eads and the surrounding country was completely submerged to a depth of two and one-half feet. On the east side of the river, between Point a la Hache and Port Eads, all crops were almost completely destroyed; the damage in this vicinity is estimated at $200,000.

Galveston, Texas: the barometer fell slowly during the 11th and morning of the 12th, accompanied by brisk northeast winds. During the afternoon of the 12th the wind backed from the north to northwest, and increased in force, attaining at 10.15 p. m. a velocity of fifty-five miles per hour, at the same time the tide was very high and the lower part of the city overflowed although the usual effect of a northwest wind is to lower the water in the bay. After 11 p. m. the wind decreased in force, and at 7 a. m. of the 13th was blowing from the southwest at the rate of sixteen miles per hour. The only damage done at Galveston was to the smaller vessels, several of which were grounded.

See "High tides" in this REVIEW for further notes relative to this storm.

V.—On the afternoon of the 12th an area of low pressure advanced to the southeast from the vicinity of the Selkirk Mountains and moved towards the headwaters of the Missouri. It moved rapidly, attended by rains in the eastern and southern quadrants. By midnight of that date a trough of low pressure extended from the Saskatchewan Valley southeastward to the Gulf of Mexico, while a storm of considerable energy was advancing over Texas, with a secondary depression forming in Kansas. This area occupying the northern part of the trough did not develop much energy inside the limits of observation, but moved northeastward and disappeared during the night of the 13th.

VI.—The elongated area of low pressure, previously described, on the afternoon of the 13th developed a well-defined storm-centre in eastern Kansas, which moved to the northeast with rapidly increasing energy and marked decrease of pressure. On the morning of the 14th it was central at Davenport, Iowa, bounded by the isobar of 29.10, and produced heavy rains in the Lake region, the Middle and Southern States, and the Mississippi Valley. On that date it passed over the Lakes, producing heavy northwesterly gales, and on the 15th moved down the Saint Lawrence Valley, disappearing on the 16th into the Gulf. During its passage over the valley of the Saint Lawrence on the 15th northwesterly gales and heavy rains prevailed in the eastern lake region and the Canadian Provinces. From the Gulf of Saint Lawrence to Lake Erie the barometric gradient was nearly one inch, and from Sandusky, Ohio, to Anticosti, Gulf of Saint Lawrence, the velocity of the wind varied from fifty-three to forty-five miles per hour, accompanied by severe thunder-storms and heavy rains.

The following notes from Signal Service observers will serve to show the severity of this storm:

Cairo, Illinois: during the 13th the barometer fell rapidly and brisk southerly winds prevailed. On the 14th the barometer rose rapidly and high westerly winds set in, maximum velocity thirty-two miles per hour. All railroad trains from northern points arrived late, obstructions having been blown upon the track by the high wind.

Springfield, Illinois: rain, heavy at times, fell during the night of the 13–14th and morning of the 14th. The rain was accompanied by high southwesterly wind, which attained at 6 a. m. a velocity of thirty-four miles per hour.

Chicago, Illinois: during the morning of the 14th the wind was fresh to high, increasing in velocity until between 1 and 2 p. m. it had attained a velocity of thirty-six miles per hour from the southwest. The barometer fell rapidly and at 12.30 p. m. stood at 29.10.

Saint Louis, Missouri: at 4.15 a. m. of the 14th the wind reached a velocity of fifty-two miles per hour from the southwest, and at 11.47 a. m. it blew from the west at the rate of forty miles per hour.

Milwaukee, Wisconsin: the barometer fell rapidly during the early morning and until 11.20 a. m. of the 14th; after remaining nearly stationary until noon it began to rise rapidly. The wind gradually veered from southeast at 7 a. m. to nw. at noon, and at 12.40 p. m. began to blow a heavy gale from the latter direction, continuing until 6 p. m.; maximum velocity forty-eight miles per hour. The gale was very severe on the lakes, driving a number of vessels ashore and doing serious damage to all kinds of shipping.

Grand Haven, Michigan: light rain began at 5.17 a. m. of the 14th and continued, with intervals of heavy rain, throughout the day. Cautionary signals were hoisted at 11.20 a. m. The brisk southerly winds that prevailed during the day at 3.20 p. m. suddenly shifted to the northwest and blew with the force of a gale; maximum velocity fifty-two miles per hour. Numerous signs and telegraph poles were blown down, while shade trees were stripped of branches or uprooted. The gale continued with unabated force throughout the night of the 14–15th and a number of vessels were obliged to go into port for shelter.

Port Huron, Michigan: a gale from the south began at 1.53 p. m. of the 14th and reached its greatest velocity at 3.40 p. m., fifty miles per hour from the southwest. The storm was very severe on the lakes; several vessels that started out before the gale set in were obliged to return to port for safety.

Mackinaw City, Michigan: fresh to brisk east and southeast winds, accompanied by heavy rain, prevailed during the morning of the 14th, at the same time the barometer fell very rapidly, reading 29.35 inches at 7 a. m. and at 3 p. m. 28.93 inches, which is the lowest ever recorded at this station. The wind was perfectly calm from 2 to 3.15 p. m., when it set in from the northwest with great force, accompanied by heavy rain and rapidly rising barometer.

Escanaba, Michigan: on the afternoon of the 14th the wind blew hard from the north and the barometer fell rapidly, reaching 29.13 at 3 p. m.; heavy rain fell during the night of the 13–14th. The storm did no damage in the immediate vicinity of Escanaba, but captains of vessels report a severe gale on the lakes; several barges were sunk on Lake Michigan and five lives lost.

Detroit, Michigan: light and heavy rain fell during the night of the 13–14th and until 11 a. m. of the 14th. The barometer fell very rapidly until 1 p. m., when it began to rise. A southwest gale set in at 9.30 a. m., shifted to west

at 2.30 p. m., reaching a velocity of fifty-two miles per hour at 3.15 p. m. Considerable damage was done throughout the city to shade trees, signs, and chimneys. Telegraph and telephone wires were grounded and all communication was cut off for several hours. Several vessels were blown from their anchorage and damaged to a considerable extent, and a number of steamers injured by being pounded against the docks. The schooner "O. M. Bond," bound from Detroit for Buffalo, laden with twenty-two thousand bushels of wheat, was driven ashore at Eau Point: the vessel and cargo were lost and two men drowned.

Fort Wayne, Allen county, Indiana: a heavy southerly gale prevailed here during the afternoon of the 14th, unroofing a large number of buildings and uprooting trees.

Vevay, Switzerland county, Indiana: rain fell during the morning of the 14th until 8 a. m., at the same time the wind blew a strong gale, attaining a maximum velocity of seventy-five miles per hour at 10.45 a. m. Numerous trees and chimneys were blown down.

Toledo, Ohio: on the morning of the 14th the barometer was low and it continued to fall until 3 p. m., when it began rising rapidly, lowest reading, 29.35, at 3 p. m. Fresh southerly winds prevailed until 8 a. m., when it began to strengthen, and veering to the southwest, increased in force until 2.30 p. m., when it reached a maximum velocity of forty-four miles per hour. During the gale the water was blown out of the Maumee River to such an extent as to lower it seven feet, this is lower than it has been at any time since 1873. Much damage was done to buildings in all parts of the city, and work on all telegraph lines was interrupted.

Columbus, Ohio: the barometer fell steadily during the night of the 13–14th and until 12.30 p. m. of the 14th, when it stood at 29.50. At 1.05 p. m. the wind blew from the southwest with the force of a gale and continued until after midnight; highest velocity forty-five miles per hour between 1 and 2 p. m. Considerable damage was done to trees, frame buildings, fences, etc.

Sandusky, Ohio: rain, very heavy at intervals, began at 6.42 a. m. of the 14th, with rapidly falling barometer. A gale set in at 8.15 a. m. and continued all day, maximum velocity fifty-three miles per hour from the west at 5.20 p. m. During the 15th the wind blew hard from the northwest and the barometer rose rapidly.

Buffalo, New York: on the morning of the 14th the sky was partly overcast with cumulo-stratus clouds moving rapidly from the west, although the surface winds were from the southeast, having backed to that point from the southwest at 8.30 a. m. At 11.20 a. m. rain commenced and continued until 1.20 p. m., with barometer falling about .05 every hour, reaching 29.31 inches at 6 p. m. At 6.30 p. m. the wind, which had been blowing briskly from the south, veered suddenly to the southwest and increased in force, attaining at 8 p. m. the velocity of sixty-three miles per hour, although between 8 and 8.05 p. m. it blew at the rate of seventy miles per hour; for the four hours ending at 11 p. m. it blew at the average velocity of fifty-three miles per hour. This storm was more destructive to life and property than any that has occurred for several years. The water in a creek that flows through the city is reported to have risen seven feet higher than was ever known before, completely submerging a portion of the city and carrying away twenty-five frame houses and drowning several persons. At 8 p. m. the German Music Hall, in course of construction, was damaged to the amount of $20,000, the entire west and southwest walls being blown down. Rain began again at 11.30 a. m. and continued throughout the night. The gale did not begin to decrease in force until 2 p. m. of the 15th, after having reached at 1 a. m. a velocity of fifty-six miles per hour. The 15th continued cloudy, with squalls of rain, rapidly rising barometer, and falling temperature. Snow fell from 11.55 p. m. of the 15th to 12.10 a. m. of the 16th. The storm signals which were hoisted at 11 a. m. of the 14th undoubtedly prevented many disasters to shipping.

Rochester, New York: during the 14th the barometer fell rapidly, and during the early morning brisk to high southerly winds set in; at 9.15 a. m. the wind had increased in force, and between 11 a. m. and noon blew from the south at the rate of forty-four miles per hour. At 9 p. m. the wind veered to southwest and shortly after again increased in force, veering to the west between 10 and 11 p. m.. The gales were accompanied by rain. During the night of the 14–15th the gale continued to veer toward the northwest, attaining a maximum velocity of thirty-eight miles per hour between 12 and 1 a. m. of the 15th. Several buildings were unroofed and otherwise damaged by the high wind.

Parkersburg, Wood county, West Virginia: the gale of the 14th unroofed houses in various places near this town, and at Tygart Creek a large dwelling house and many fences and hay-stacks were blown down. At Point Pleasant the roundhouse on the Ohio River Railroad was demolished.

VII.—The midnight map of the 15th showed a depression of moderate extent developing in northern California, which had probably entered from the Pacific during the afternoon of that date. On the 16th this area, bounded by the isobar of 29.90, moved eastward, and was followed by an area of high pressure central on the Pacific coast. It developed little energy, however, until the afternoon of the 17th, when it became a well-defined depression, bounded by the isobar of 29.8, and central east of Salt Lake City, Utah, and moving slowly over the Rocky Mountains. It extended on the morning of the 18th in a pear-shaped, irregular ellipse to the Gulf of California. On that date the pressure at the centre rapidly decreased to 29.5, with heavy southwesterly winds in Arizona and New Mexico, and southeasterly winds in Kansas and the Indian Territory. Very little rainfall attended its advance eastward on the 18th, and it gradually dissipated on the 19th by increase of pressure under the influence of a depression developing in Minnesota.

VIII.—This area, first noted on the afternoon map of the 19th, appeared as a secondary depression in the northern part of the trough of low pressure in the rear of low area number vii, and extending from the Rio Grande to the Saskatchewan. To the west of this a high area existed with its major axis in a line from the coast of Oregon to Salt Lake City, Utah. This low area first moved northward on the 19th and then curved to the east, followed by the area of high pressure which moved over the central Rocky Mountain region, Kansas, and Nebraska, producing heavy rains in the upper Mississippi valley. On the 20th it moved rapidly eastward, attended with rains in the Canadian Provinces and the Lake region, the centre of disturbance being north of the Saint Lawrence, and on the 21st disappeared eastward beyond the limits of observation, producing heavy rains in the lower lake region and Canada. The passage of this area over the Lake region was accompanied by heavy northwesterly gales.

IX.—An area of high pressure was central over the Ohio Valley, and another over California and Nevada on the afternoon of the 22d. In the northern part of the trough of low pressure which separated these two areas a storm-centre developed and moved to the southeast from the Saskatchewan Valley on that date, producing light rains in Minnesota, Dakota, and Iowa, and heavy thunder-storms in Kansas. The influence of the high area to the eastward somewhat retarded the progress of the storm-centre. The rain-area in front of the depression extended from Manitoba to northern Texas and eastward over the upper Mississippi valley. In the southern quadrant of the storm-centre the thunder-storm area extended from Dakota to the Valley of the Red River on the line of the major axis of the trough of low pressure. On the morning of the 24th the centre of disturbance was north of Lake Superior, and high northwesterly winds prevailed in Dakota and Nebraska, with southerly to southeasterly winds in the Lake region during that day. On the 25th the centre of disturbance drew slowly eastward north of the Saint Lawrence and disappeared beyond the limits of observation.

NORTH ATLANTIC STORMS DURING OCTOBER, 1886.

[*Pressure in inches and millimetres; wind-force by Beaufort scale.*]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to November 21, 1886.

Fourteen depressions are traced, of which one, number 11, was a continuation of an area of low pressure which first appeared over the North American continent; number 1 was a continuation of ocean depression number 10 traced for September; number 2 continued land depression number xi charted for September; number 3 first appeared in the sub-tropical region north of the West Indies on the 3d and moved slowly northeastward until the 13th, from which date its forward motion was greatly accelerated, and the centre of depression passed to the northward of the British Isles by the night of the 14th or the morning of the 15th. This storm was very destructive on the British and French coasts from the 14th to the 16th, and, by reason of its track across the Atlantic being far to the southward of the generality of storms traced, surmises have been made in maritime circles as to its probable